Sentinels

Inner Heliospheric Sentinels

LWS Science Workshop
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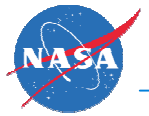
NASA/GSFC Code 696



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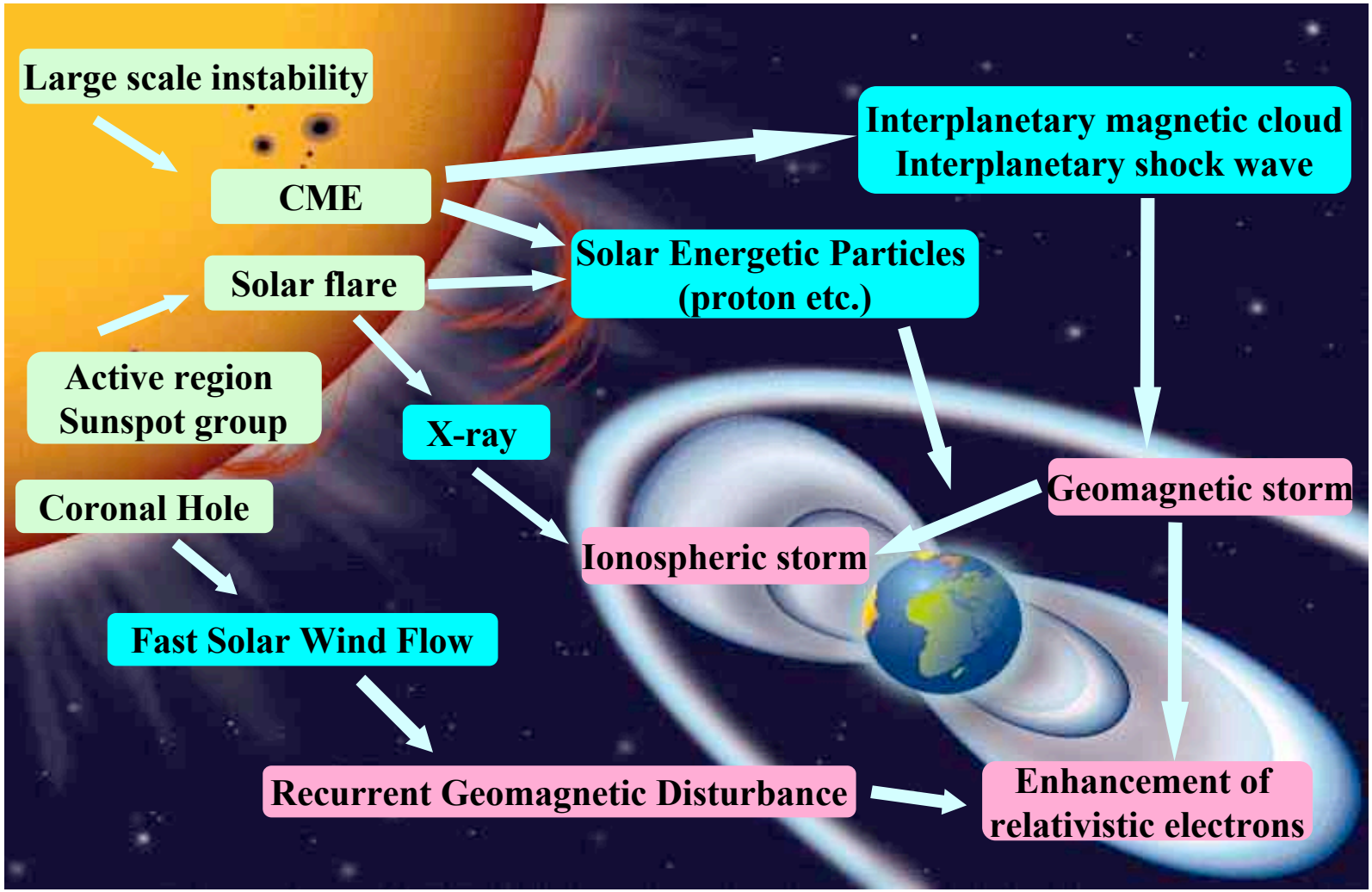
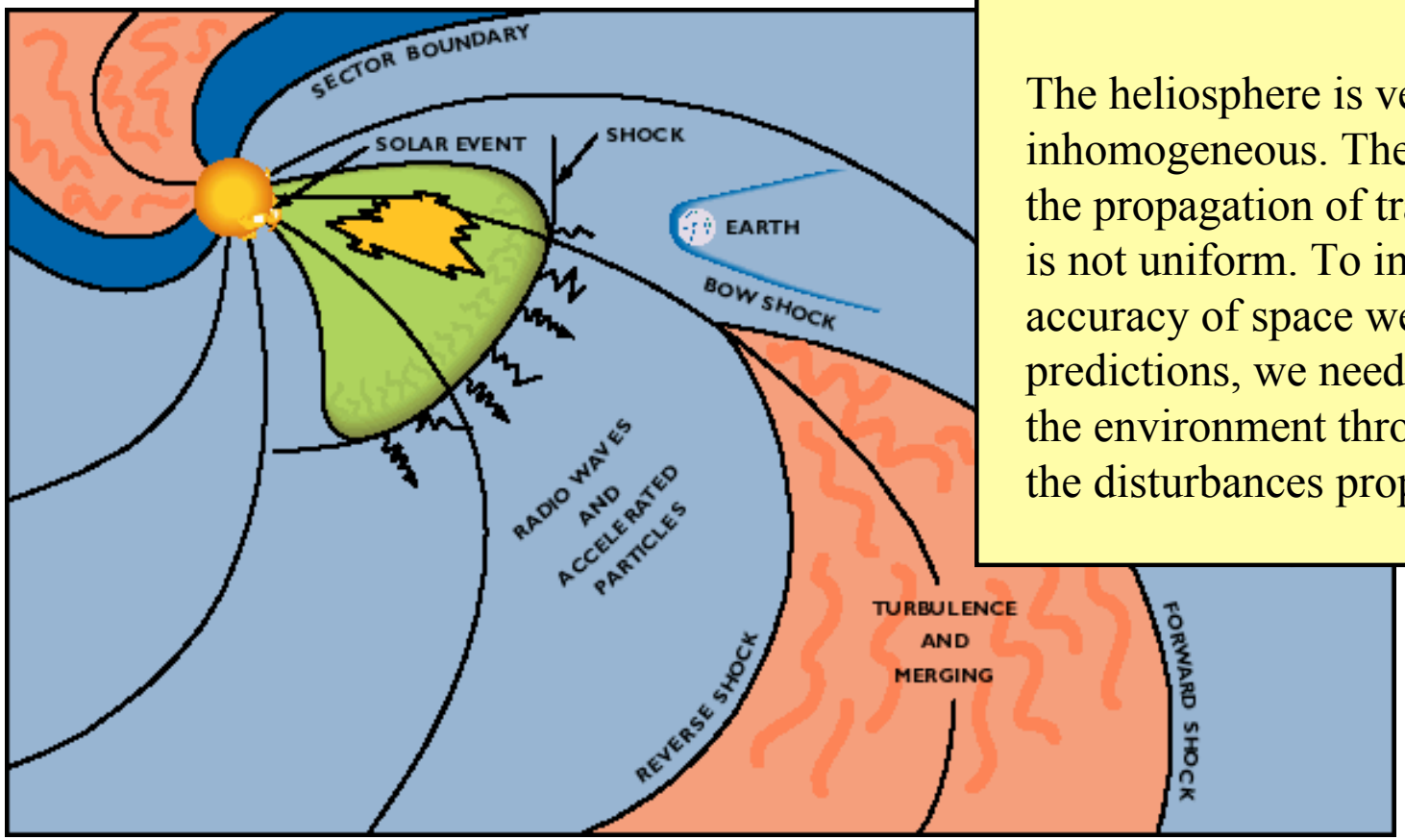
Space Weather Disturbances



How do large-scale structures propagate?



The heliosphere is very inhomogeneous. Therefore, the propagation of transients is not uniform. To improve accuracy of space weather predictions, we need to know the environment through which the disturbances propagate.

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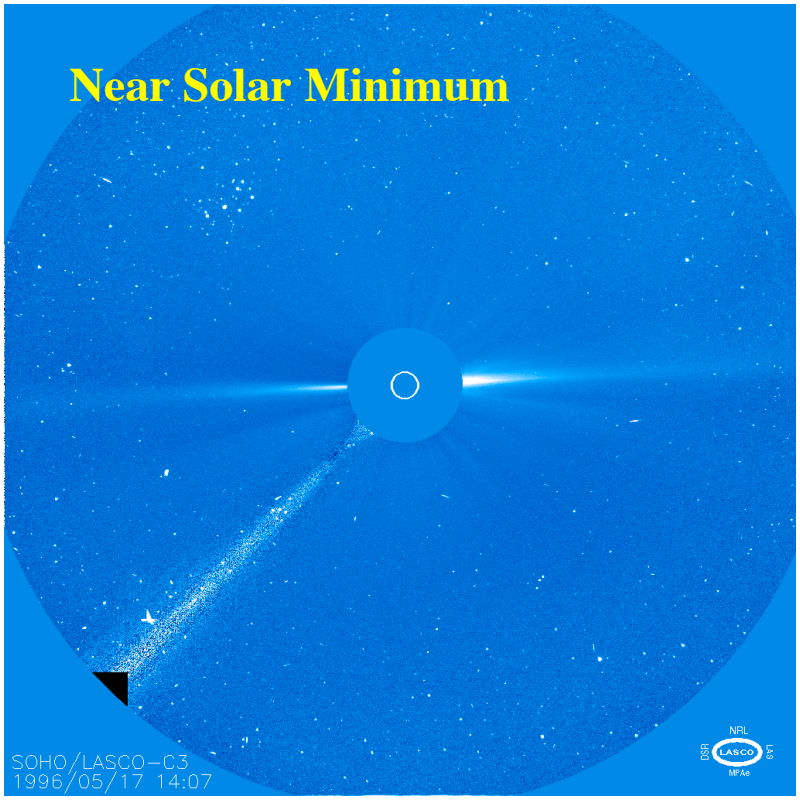
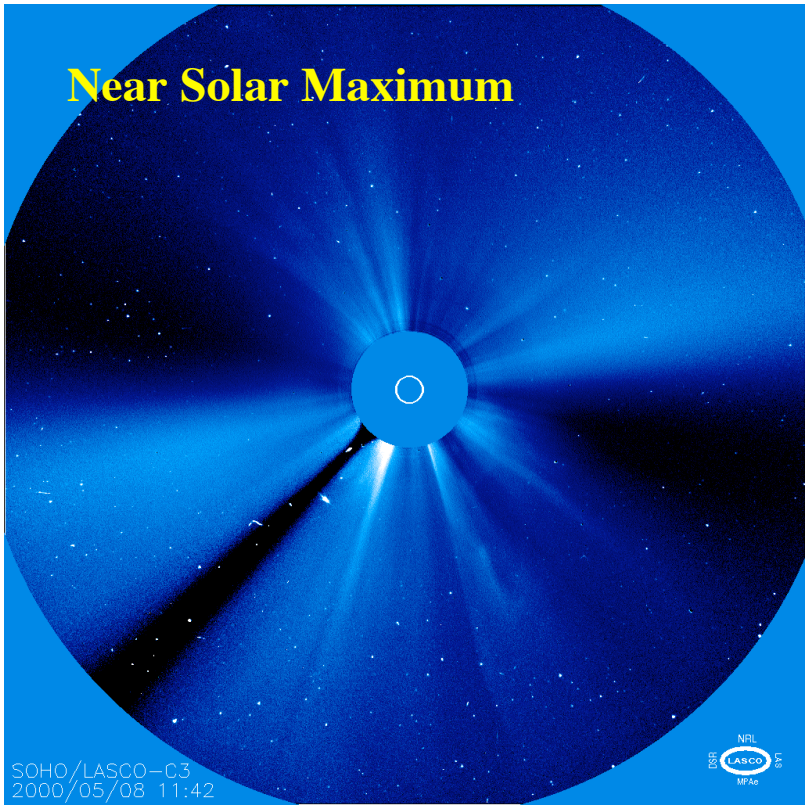
How does the global character of the heliosphere change with time?





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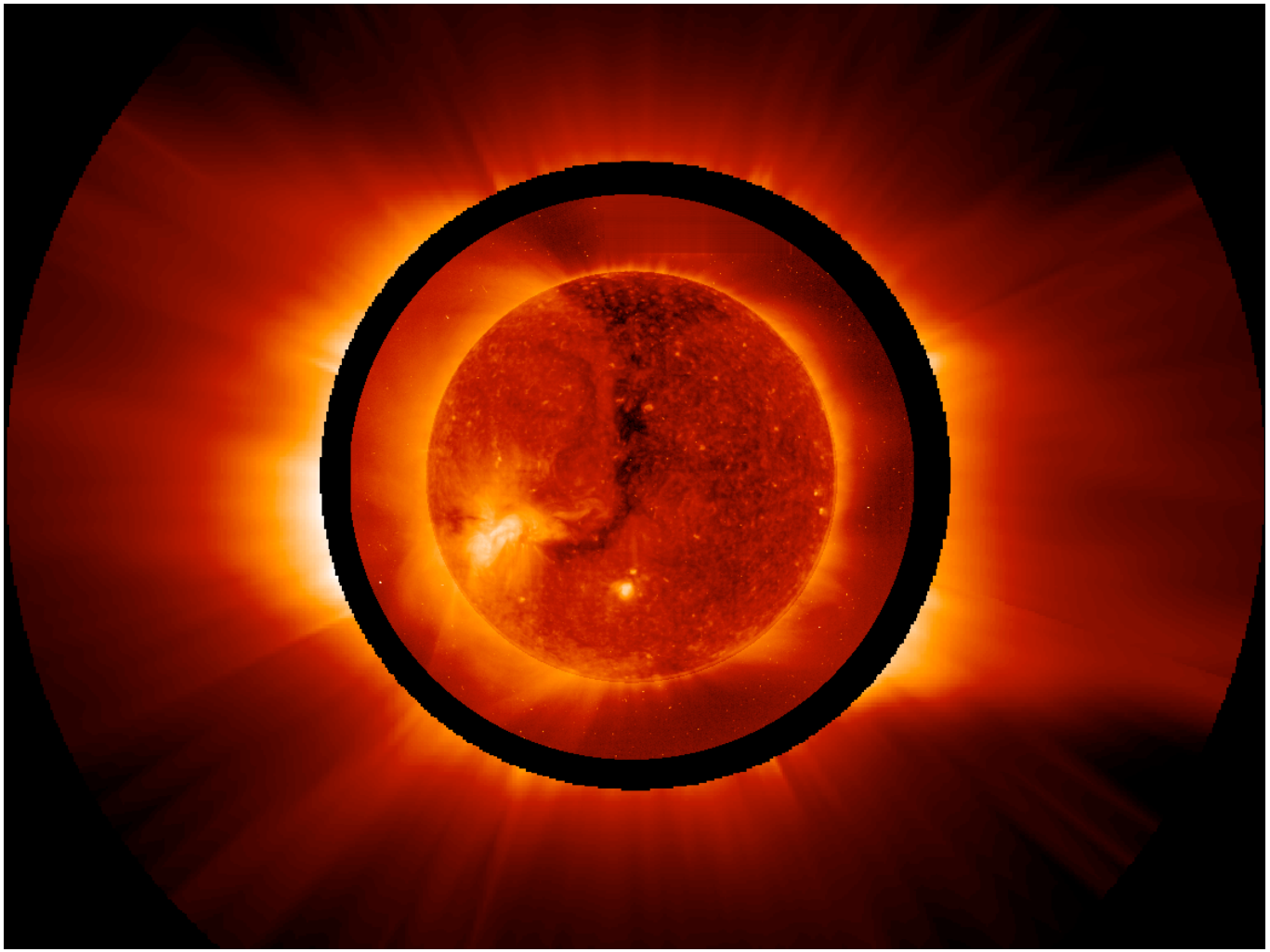
What solar features/events correspond to heliospheric structures?



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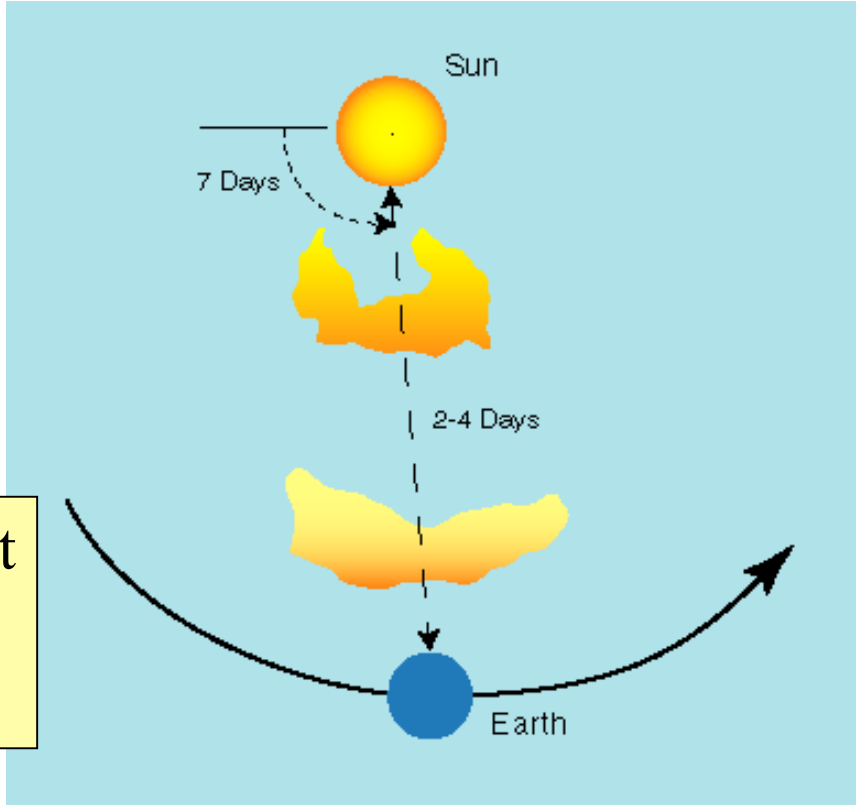
* **What solar dynamic processes are responsible for the release of geoeffective events?**
* **How and where are energetic particles released and accelerated?**

- Regions of activity take weeks to develop.
- In 7 days solar limb rotates to central meridian

In order to observe the development of regions of activity we must also observe the solar far side.



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Sentinels Scientific Objectives

- **Determine the structure and long-term (solar cycle and much longer) climatic variations of the ambient solar wind in the inner heliosphere.**
- **Determine how large-scale solar wind structures propagate and evolve in the inner heliosphere.**
- **Determine what dynamic processes are responsible for the release of geoeffective events.**
- **Determine how and where are energetic particles released and accelerated.**

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Primary Science Objectives

Science Objectives	Space Weather Application	Measurement Requirement	Location
What is the ambient 3D structure of the heliosphere near the ecliptic?	Increase accuracy of forecasts Input to climatology models Radial profile	Solar wind plasma and composition	From various radial and longitudinal ventage points in the inner heliosphere
		Vector magnetic field	
		Energetic particles	
		Remote sensing of heliosphere	
How do large structures evolve during transit to Earth? (CMEs, Shocks, Fast Streams)	Increase accuracy of forecasts Input to models Radial profile	Solar wind plasma and composition	From various radial and longitudinal ventage points in the inner heliosphere
		Vector magnetic field	
		Radio burst tracker	
		Remote sensing of heliosphere	
		Remote sensing of photosphere/corona	Both sides of the Sun
What are the dynamic processes in the corona as can be determined from heliospheric observations?	Identify source regions and mechanisms hence provide forecasting capability.	Solar wind plasma and composition	From various radial and longitudinal ventage points in the inner heliosphere
		Vector magnetic field	
		Energetic particles	
		Remote sensing of photosphere/corona	Both sides of the Sun
How and where are energetic particles released and accelerated?	Develop SEP forecasting capability.	Energetic particles	From various radial and longitudinal ventage points in the inner heliosphere
		Radio burst tracker	
		Vector magnetic field	
		Remote sensing of photosphere/corona	Both sides of the Sun

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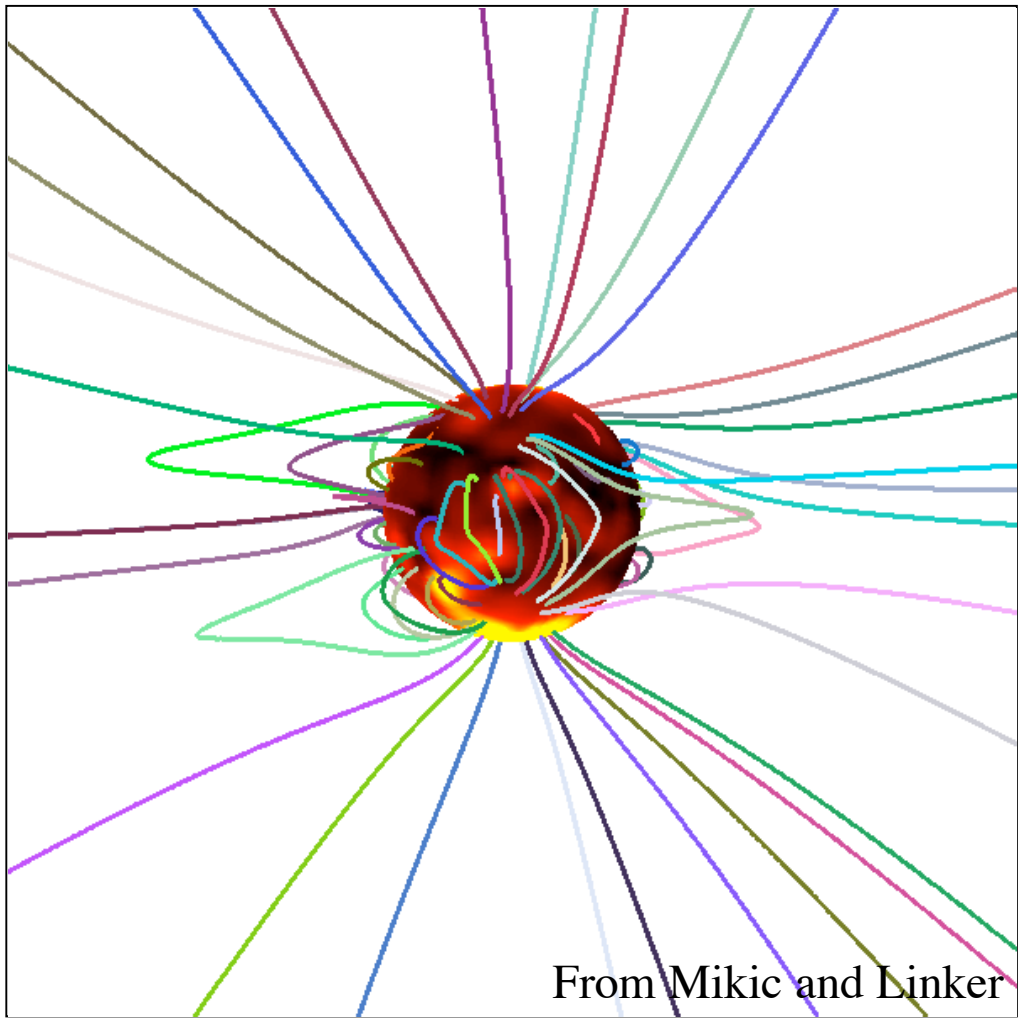
Global Models



- **For inner boundary conditions need solar data from both halves of the Sun.**
- **In situ observations are needed to validate the models.**

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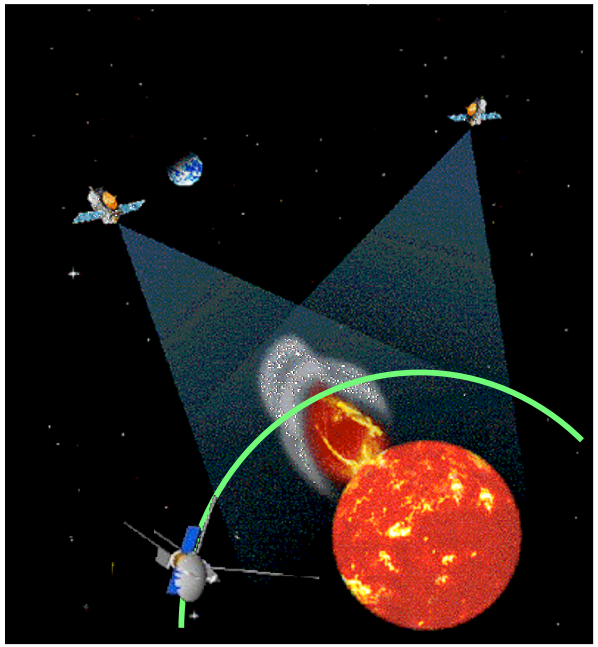
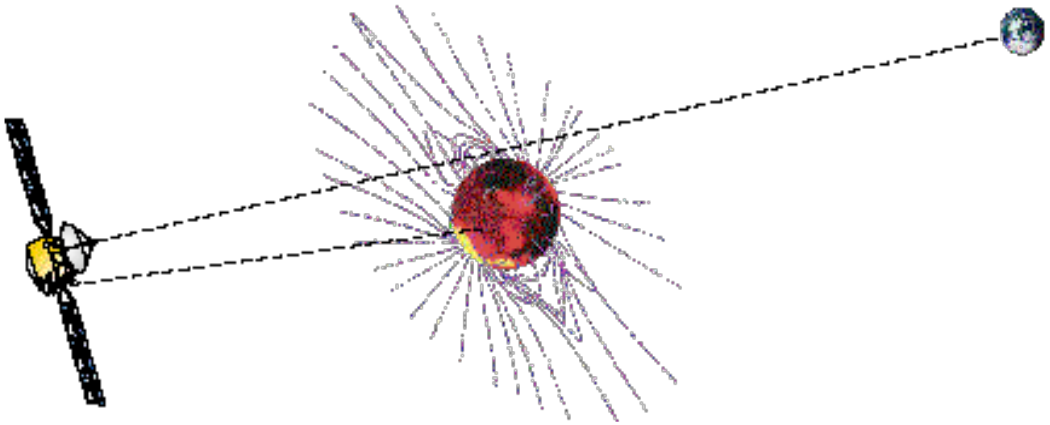
Calibrate Remote Sensing



Obtain in situ observations calibrating STEREO heliospheric imager data.

Coronal sounding for magnetic field intensity calibrations



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Secondary Science Objectives

Science Objectives	Space Weather Application	Measurement Requirement	Location
What is the origin and nature of the solar dynamo?	Long-term solar activity prediction capability.	Doppler magnetograph	Wide longitudinal separation
How do active regions evolve?	Long-term (> week) prediction of the occurrence and intensity of CMEs and flares.	EUV Solar observations	Both sides of the Sun
		Photospheric magnetic field	
		Radio occultation	From far side of Sun
What is the mechanism of ejection of mass and energy from the Sun?	Predict occurrence and intensity of CMEs and flares.	EUV Solar observations	Both sides of the Sun
		Photospheric magnetic field	
		In situ observations	
		Radio occultation	From far side of Sun

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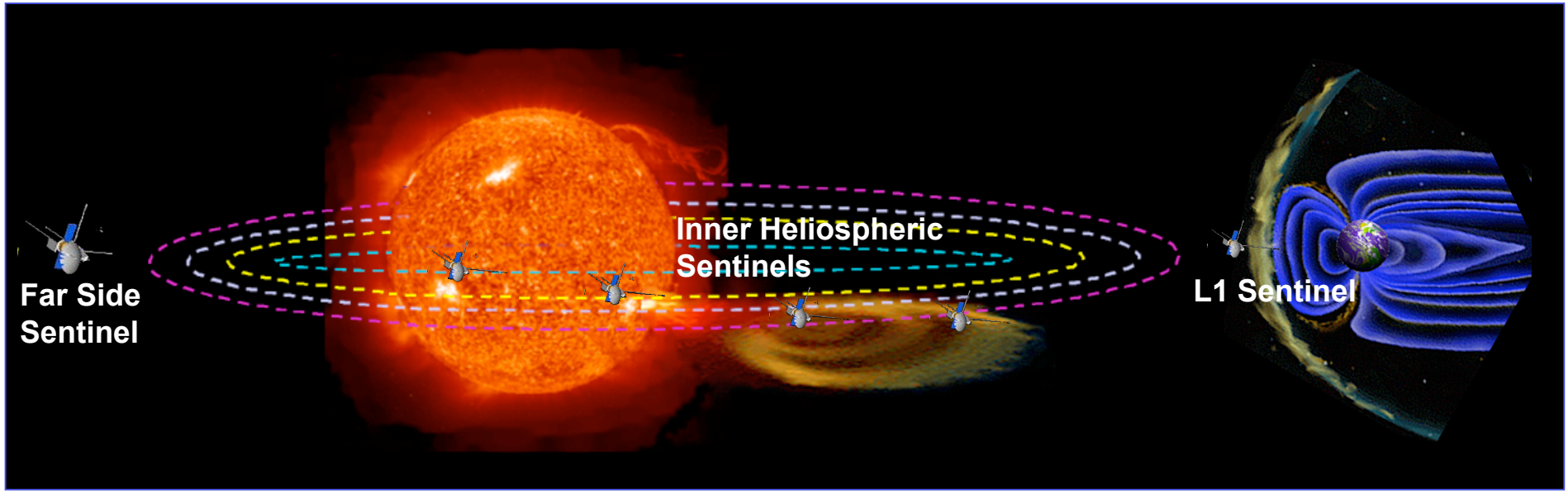
SENTINEL ELEMENTS



- Far Side Sentinel - 3-axis stabilized spacecraft
- Inner Heliospheric Sentinels - 4 spinning s/c in 0.5-0.95 AU heliocentric orbits
- L1 Sentinel - Spinning s/c in L1 Halo orbit

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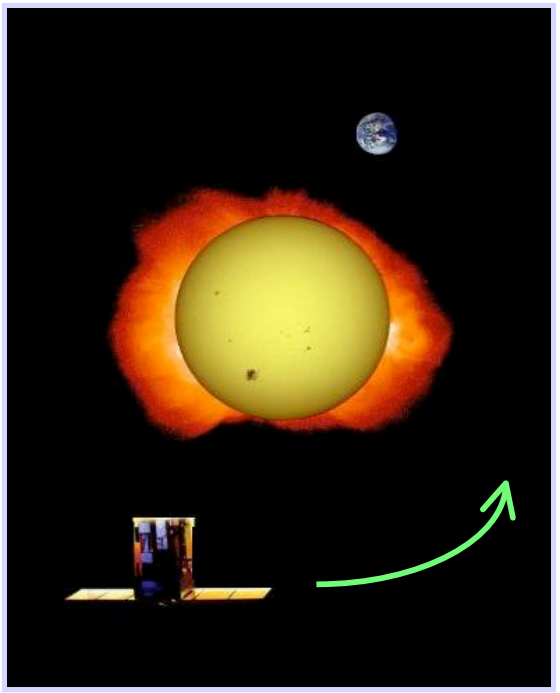
Far Side Observatory:

3-axis stabilized s/c in 1 AU heliocentric orbit slowly drifting from near 180 degrees solar longitude to 240 degrees on the east limb in 3 years.

Instruments:

EUV / Irradiance
Doppler-Magnetograph
Radio Occultation
Magnetometer
Solar Wind Analyzer
Energetic Particle Detectors



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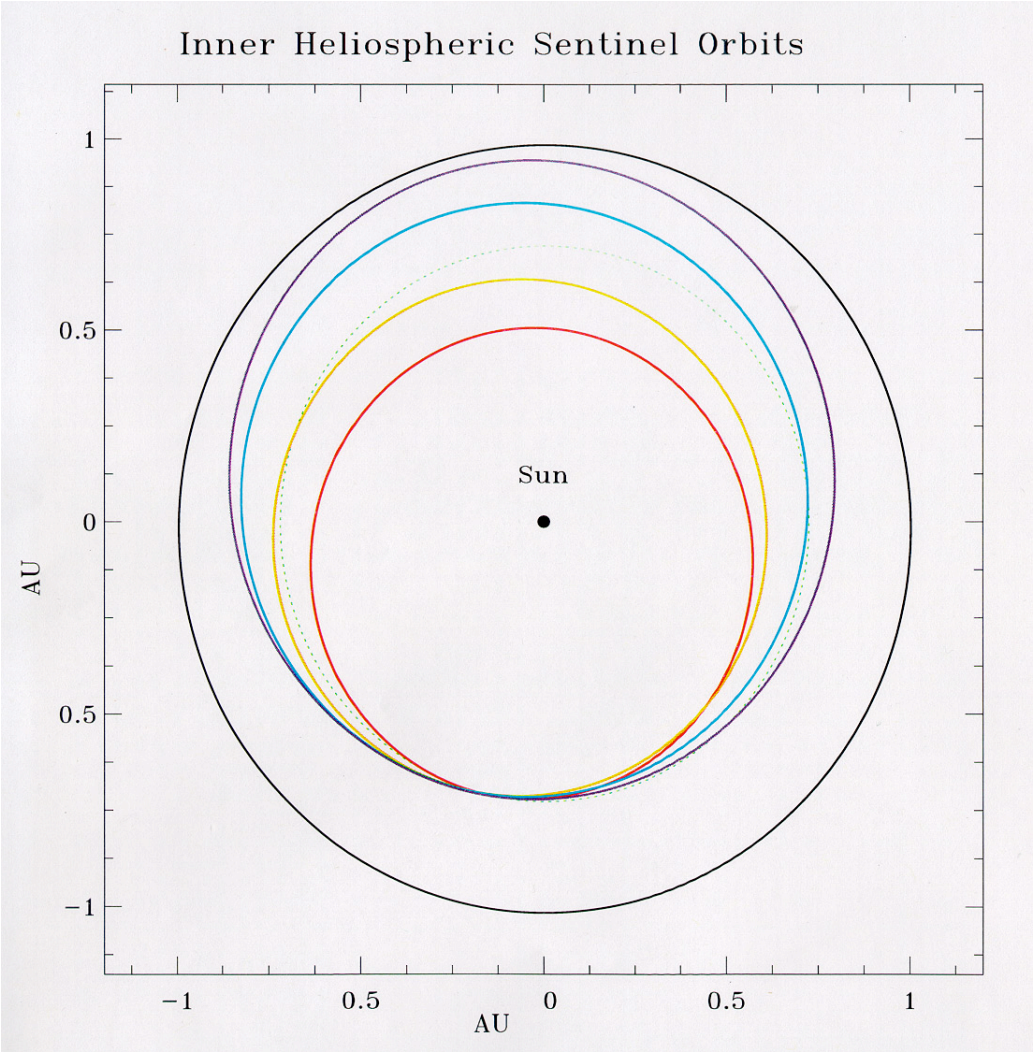
IHS Elcliptic Orbits



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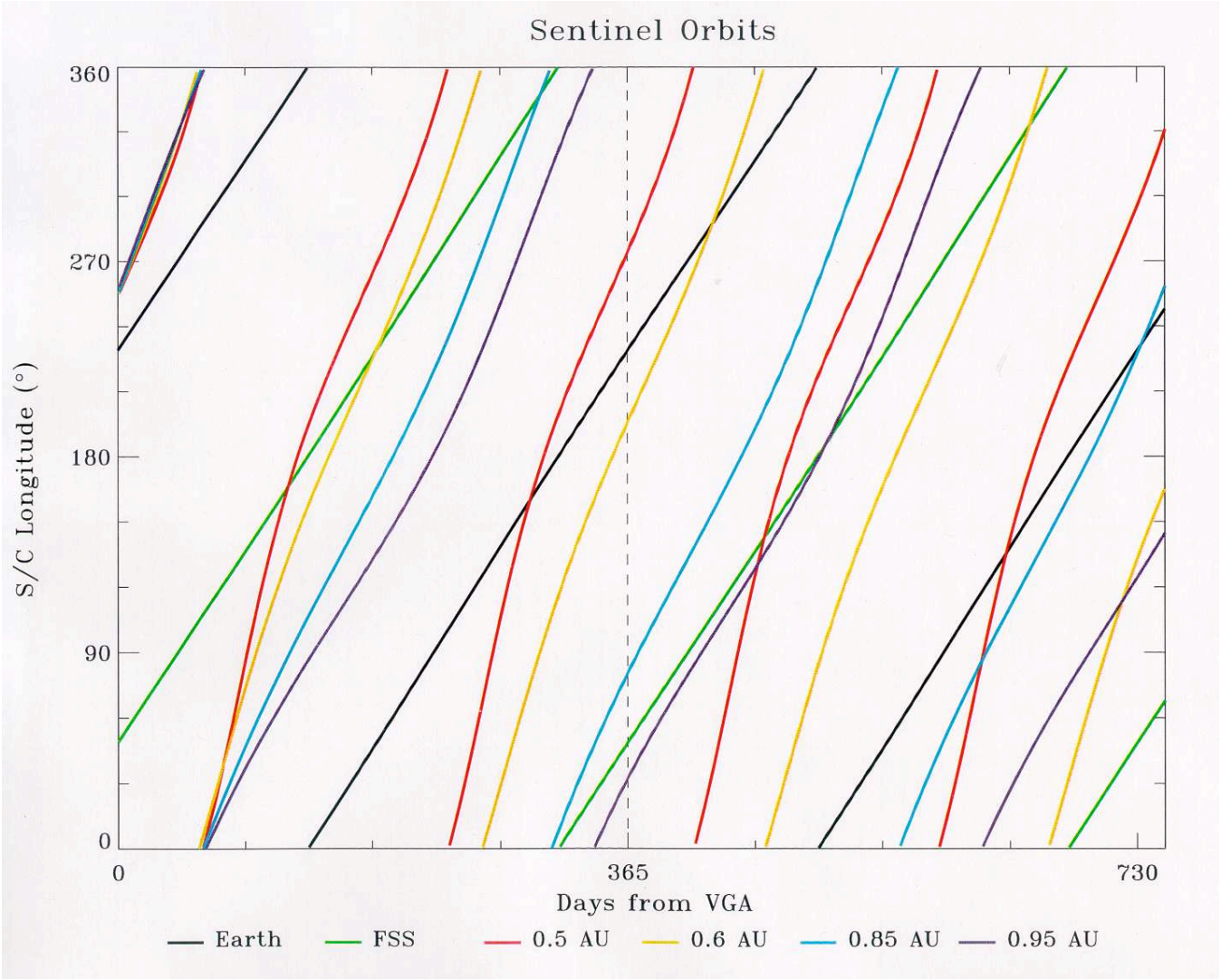
IHS Solar Inertial Longitudes for 2 Years



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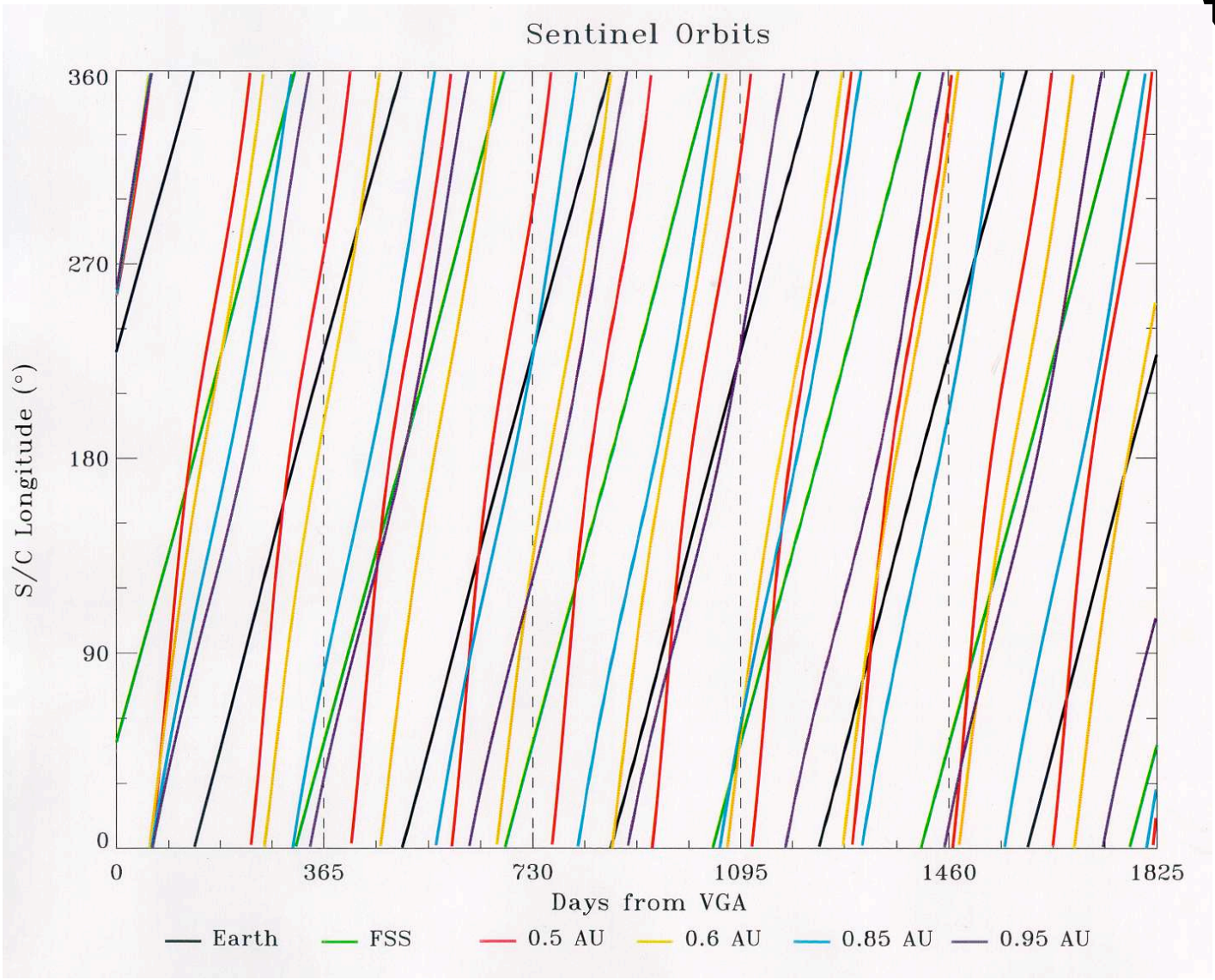
IHS Solar Inertial Longitudes for 5 Years



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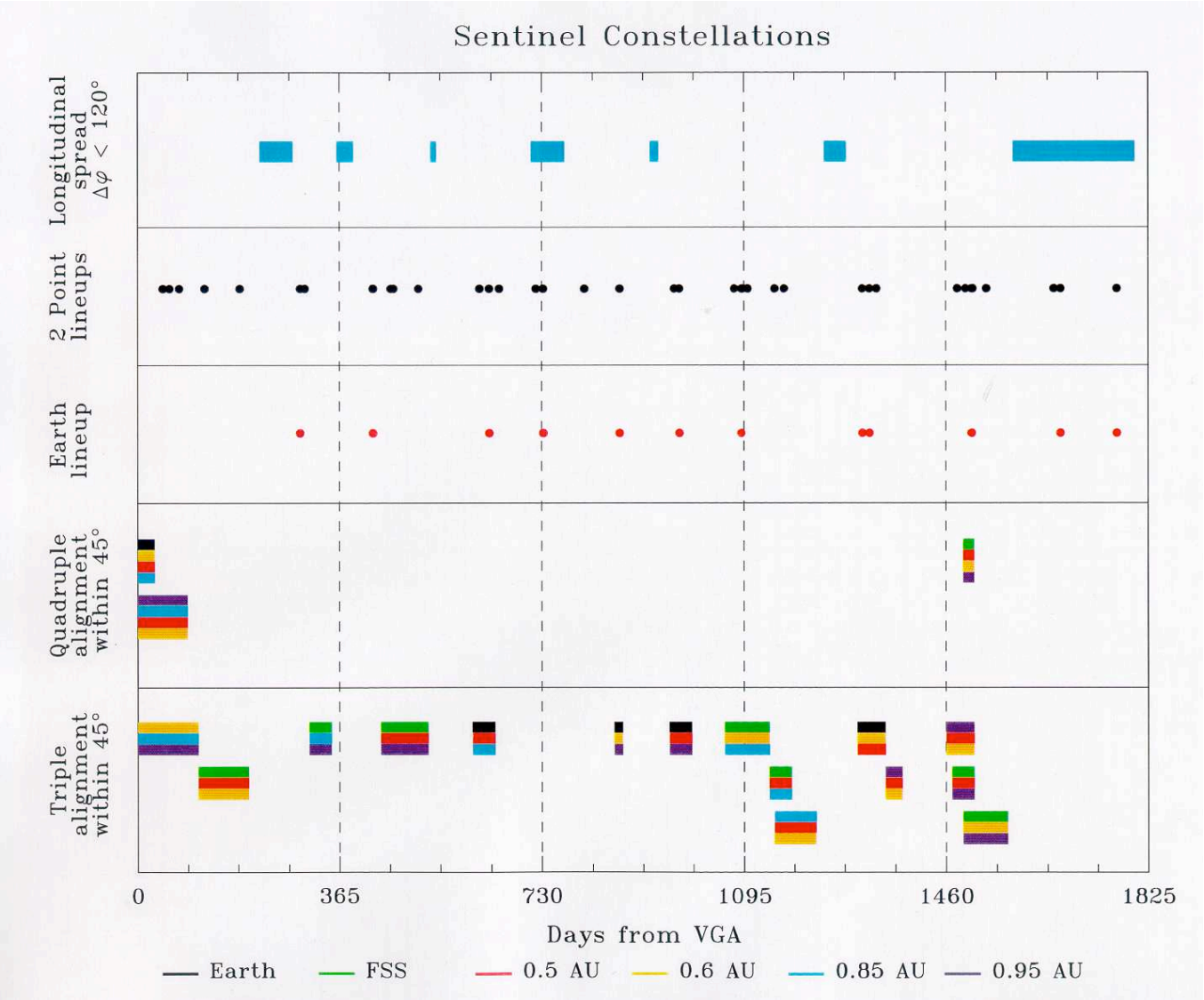
IHS Constellation Opportunities



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Summary: SENTINELS

Primary LWS Task:

Carry out scientific observations and research that will enable and improve space weather predictions.

Region of Focus: the Heliosphere

Objectives of SENTINELS:

- Global characterization of the heliosphere.
- Transit and evolution of geoeffective structures.
- Connecting geoeffective structures to solar features/activity.
- Location and mechanism of energetic particle release and acceleration.